

add C 26 add 148 CLAIMS

1. A hydraulic control valve, in which a valve spool is fitted into a cylindrical valve body so as to be changeable in relative angle, a plurality of first oil grooves provided on a fitted peripheral surface of said valve body and a plurality of second oil grooves provided on a fitted peripheral surface of said valve spool are placed alternatively, gaps between said first and second oil grooves which are adjacent in the peripheral direction act as throttle portions which change throttle areas in accordance with a relative angular displacement between said valve body and valve spool, ones of said first and second oil grooves alternately act as oil supply chambers and oil discharge chambers, and the others act as oil feed chambers interposed between said oil supply chambers and oil discharge chambers, characterized by comprising:

chamfers, for adjusting said throttle areas, provided on corner portions of ones of said first and second oil grooves which face said throttle portions between said oil supply chambers and oil feed chambers or which face said throttle portions between said oil discharge chamber and oil feed chambers, wherein the corner portions are the ones closer to the others of said first and second oil grooves.

2. The hydraulic control valve according to claim 1, wherein said chamfer portions are provided on the corner



wherein said chamfer portions are provided on corner portions of ones of said first and second oil grooves which face said throttle portions between said oil supply chambers and oil feed chambers or which face said throttle portions between said oil discharge chamber and oil feed chambers, wherein the corner portions are the ones closer to the others of said first and second oil grooves.

5. A power steering apparatus, comprising a hydraulic pump, being driven by an electric motor, for supplying oil pressure to a hydraulic cylinder for steering assistance; and a hydraulic control valve, interposed in a hydraulic pressure path between said hydraulic pump and hydraulic cylinder, for controlling oil pressure from said hydraulic pump to two cylinder chambers included in said hydraulic cylinder, characterized in that:

said hydraulic control valve is the hydraulic control valve described in ~~any one of claims 1 to 4.~~

6. The power steering apparatus according to claim 5, wherein said hydraulic pump is driven such that a flow rate becomes low flow rate or zero flow rate when steering is not carried out, and such that the flow rate becomes high in accordance with steering angular velocity when steering is carried out.

7. The power steering apparatus according to claim 5, wherein said electric motor drives said hydraulic pump such

that oil pressure is supplied at zero flow rate or predetermined small flow rate as small as possible when steering is not carried out, and the oil pressure is abruptly supplied at high flow rate in accordance with the steering angular velocity as the steering is carried out.

8. A power steering apparatus, comprising a hydraulic pump, being driven by an electric motor, for supplying oil pressure to a hydraulic cylinder for steering assistance; and a hydraulic control valve, interposed in a hydraulic pressure path between said hydraulic pump and hydraulic cylinder, for controlling oil pressure from said hydraulic pump to two cylinder chambers included in said hydraulic cylinder, in said hydraulic control valve, a valve spool is fitted into a cylindrical valve body so as to be changeable in relative angle, a plurality of first oil grooves provided on a fitted peripheral surface of said valve body and a plurality of second oil grooves provided on a fitted peripheral surface of said valve spool are placed alternatively, gaps between said first and second oil grooves which are adjacent in the peripheral direction act as throttle portions which change throttle areas in accordance with a relative angular displacement between said valve body and valve spool, ones of said first and second oil grooves alternately act as oil supply chambers and oil discharge chambers, and the others serve oil feed chambers interposed between said oil supply

chambers and oil discharge chambers, characterized in that:

said hydraulic control valve having chamfers, for adjusting said throttle areas, provided on corner portions of ones of said first and second oil grooves which face said throttle portions between said oil supply chambers and oil feed chambers or which face said throttle portions between said oil discharge chamber and oil feed chambers, wherein the corner portions are the ones closer to the others of said first and second oil grooves.

9. The power steering apparatus according to claim 8, wherein said chamfer portions are provided on the corner portions each facing the throttle portion where a flow is generated from said second oil groove toward said first oil groove.

10. The power steering apparatus according to claim 8 or 9, wherein said hydraulic pump is driven such that a flow rate becomes low flow rate or zero flow rate when steering is not carried out, and such that the flow rate becomes high in accordance with steering angular velocity when steering is carried out.

11. The power steering apparatus according to claim 8 or 9, wherein said electric motor drives said hydraulic pump such that oil pressure is supplied at zero flow rate or predetermined small flow rate as small as possible when steering is not carried out, and the oil pressure is abruptly

supplied at high flow rate in accordance with the steering angular velocity as the steering is carried out.

12. A power steering apparatus, comprising a hydraulic pump, being driven by an electric motor, for supplying oil pressure to a hydraulic cylinder for steering assistance; and a hydraulic control valve, interposed in a hydraulic pressure path between said hydraulic pump and hydraulic cylinder, for controlling oil pressure from said hydraulic pump to two cylinder chambers included in said hydraulic cylinder, in said hydraulic control valve, a valve spool is fitted into a cylindrical valve body so as to be changeable in relative angle, a plurality of first oil grooves provided on a fitted peripheral surface of said valve body and a plurality of second oil grooves provided on a fitted peripheral surface of said valve spool are placed alternatively, gaps between said first and second oil grooves which are adjacent in the peripheral direction act as throttle portions which change throttle areas in accordance with a relative angular displacement between said valve body and valve spool, ones of said first and second oil grooves alternately act as oil supply chambers and oil discharge chambers, and the others act as oil feed chambers interposed between said oil supply chambers and oil discharge chambers, characterized in that:

said hydraulic control valve having chamfers, for adjusting said throttle areas, each provided on a corner

portion facing said throttle portion where a flow is generated from said second oil groove toward said first oil groove.

13. The power steering apparatus according to claim 12, wherein said chamfers are provided on corner portions of ones of said first and second oil grooves which face said throttle portions between said oil supply chambers and oil feed chambers or which face said throttle portions between said oil discharge chamber and oil feed chambers, wherein the corner portions are the ones closer to the others of said first and second oil grooves.

14. The power steering apparatus according to claim 12 ~~or 13~~, wherein said hydraulic pump is driven such that a flow rate becomes low flow rate or zero flow rate when steering is not carried out, and such that the flow rate becomes high in accordance with steering angular velocity when steering operation is carried out.

15. The power steering apparatus according to claim 12 ~~or 13~~, wherein said electric motor drives said hydraulic pump such that oil pressure is supplied at zero flow rate or predetermined small flow rate as small as possible when steering is not carried out, and the oil pressure is abruptly supplied at high flow rate in accordance with the steering angular velocity as the steering is carried out.